A16-019 Phase 1 Summary Report

Vibrant Composites Inc.
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I. Abstract

A combined transducer capable of bone conduction audio and inertial haptics would enhance situational awareness, but this need has not been met by current technical solutions. In this Phase I SBIR topic A16-019, Vibrant Composites Inc. has extended its nonlinear resonant actuator (NLRA) haptics technology towards creating such dual-use component. Initially developed to enable the most precise haptic communication components, NLRA technology has the potential to create a combined transducer core capable of both precise haptic communication and high fidelity bone conduction audio. The transducer design leverages Micro-Multilayer Etched Composite System (μMECS) manufacturing innovations to achieve a miniaturized form factor suitable for integration into a flexible, lightweight head-mounted system. In this Phase I SBIR, Vibrant Composites has delivered functional dual-mode bone conduction and vibrotactile transducer prototypes.

II. Background

The challenge posed by the solicitation was to create a compact transducer capable of both bone-conduction audio and haptic effects. The former application requires creating low amplitude audio frequency displacements in bone, while the latter application requires creating high amplitude displacements in soft tissue at frequencies in the 50Hz-300Hz range.

III. Summary of Phase I Results

Vibrant Composites has designed a dual-mode bone conduction and vibrotactile transducer. We have manufactured actuator prototypes using our μMECS technology and demonstrated their functionality in the laboratory and at an on-site visit with program managers.

Using the prototype, we were able to successfully demonstrate simultaneous bone conduction audio and haptic feedback effects. Haptic performance, as measured on an industry-standard 3-axis accelerometer characterization setup with 100 gram proof mass, was approximately 1G tap and 1.5G sustained vibration. While we were unable to accommodate a detailed quantitative evaluation of the acoustic operating mode within the Phase 1 budget, the transducer was capable of transmitting intelligible voice and good fidelity music playback at a volume exceeding that of many commercial bone conduction transducers.

IV. Technology Description

Vibrant's design of a dual-mode bone conduction audio and haptic transducer incorporates our existing NLRA haptics architecture for high fidelity vibrotactile feedback. The hybrid actuator combines a low-force, high-stroke voice coil actuator used to drive the NLRA input with a high-force, low-stroke variable reluctance actuator used for the acoustic operating mode.

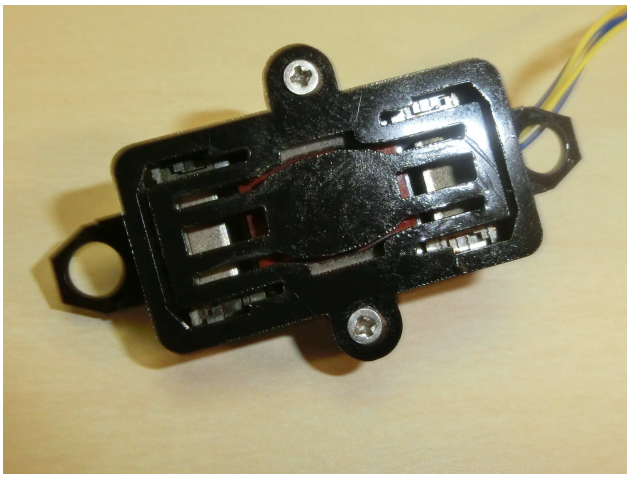

Fig. 1. Vibrant Composites dual-mode bone conduction and vibrotactile transducer

V. Applications and Customers

The dual-mode bone conduction and vibrotactile transducer can assist in unburdening two sensory channels - vision and hearing - of a Warfighter. Its ideal use is as a component of a head-mounted communication system for CBRNE and Special Operations Forces exposed to many simultaneous sensory inputs. Additionally, professional entities such as firefighters, rescue squads, aero-medical evacuation personnel, and law enforcement agencies are target customers. Vibrant will work with these entities and existing head mounted communication equipment suppliers to commercialize our transducer technology.